05-26-00

UTILITY PATENT APPLICATION TRANSMITTAL

(Only for new nonprovisional applications under 37 CFR 1.53(b))

Title of Invention	**PLANE CARBON COMMUTATOR AND PRODUCING METHOD THEREOF**
Named Inventor(s)	**KENICHI SUGIYAMA**
Attorney Docket	**13700-0238**
Express Mail Label No.	**EL498680306US**

APPLICATION ELEMENTS

1. ☒ Fee Transmittal Form
   (Submit an original, and a duplicate for fee processing)
2. ☒ Specification, Claims, and Abstract — Total Pages 10
3. ☒ Drawings — Total Sheets 5
4. Oath or Declaration — Total Pages 1
   a. ☒ Newly executed (original or copy)
   b. ☐ Copy from prior application (37 CFR 1.63(d))
   (for continuation/divisional with Box 17 completed)
   [Note Box 5 Below]
   (i) ☐ DELETION OF INVENTOR(S)
   Signed statement attached deleting inventor(s) named in the prior application, see 37 CFR 1.63(d)(2) and 1.33(b).
5. ☐ Incorporation by Reference
   (usable if Box 4b is checked)
   The entire disclosure of the prior application, from which a copy of the oath or declaration is supplied under Box 4b, is considered as being part of the disclosure of the accompanying application and is hereby incorporated by reference therein.
6. ☐ Microfiche Computer Program *(Appendix)*
7. ☐ Nucleotide and/or Amino Acid Sequence Submission *(if applicable, all necessary)*
   a. ☐ Computer Readable Copy
   b. ☐ Paper Copy (identical to computer copy)
   c. ☐ Statement verifying identity of above copies

ADDRESS TO: Assistant Commissioner for Patents
Box Patent Application
Washington, D.C. 20231

ACCOMPANYING APPLICATION PARTS

8. ☒ Assignment:
   a. ☒ Assignment Papers (cover sheet & document(s))
   b. ☐ Assignment is of record in parent application No. _____
9. ☐ 37 CFR 3.73(b) Statement
   (when there is an assignee)
   ☐ Power of Attorney by assignee
10. ☐ English Translation Document *(if applicable)*
11. ☐ Information Disclosure Statement (IDS) PTO-1449
    ☐ Copies of IDS Citations
12. ☐ Preliminary Amendment
13. ☒ Return Receipt Postcard (MPEP 503)
    (Should be specifically itemized)
14. ☒ Small Entity Statement(s)
    ☐ Statement filed in prior application
    Status still proper and desired
15. ☐ Certified Copy of Priority Document(s)
16. ☐ Other: _____

17. If a **CONTINUING APPLICATION**, *check appropriate box and supply the requisite information*:
    ☐ Continuation ☐ Divisional ☐ Continuation-in-part (CIP) of prior application No:

18. CORRESPONDENCE ADDRESS:

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By: _____ Reg. No. 22,176
Date: May 25, 2000
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Facsimile: 404-949-2499

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

In re Application or Patent of: **KENICHI SUGIYAMA**)
Filed or Issued: Concurrently Herewith) Attorney's Docket No. **13700-0238**
For: **PLANE CARBON COMMUTATOR AND PRODUCING METHOD THEREOF**)

VERIFIED STATEMENT (DECLARATION) CLAIMING SMALL ENTITY STATUS (37 CFR 1.9 (f) AND 1.27 (c)) - SMALL BUSINESS CONCERN

I hereby declare that I am:

(X) the owner of the small business concern identified below:
( ) an official of the small business concern empowered to act on behalf of the concern identified below:

NAME OF CONCERN: SUGIYAMA SEISAKUSYO CO., LTD.

ADDRESS OF CONCERN: 2-15-21 , Meguro-honcho, Meguro-ku, Tokyo, Japan

I hereby declare that the above identified small business concern qualifies as a small business concern as defined in 13 CFR 121.3-18, and reproduced in 37 CFR 1.9(d), for purposes of paying reduced fees under Section 41 (a) and (b) of Title 35, United States Code, in that the number of employees of the concern, including those of its affiliates, does not exceed 500 persons. For purposes of this statement, (1) the number of employees of the business concern is the average over the previous fiscal year of the concern of the persons employed on a full-time, part-time or temporary basis during each of the pay periods of the fiscal years, and (2) concerns are affiliates of each other when either, directly or indirectly, one concern controls or has the power to control the other, or a third party or parties controls or has the power to control both.

I hereby declare that rights under contract or law have been conveyed to and remain with the small business concern identified above, with regard to the invention entitled "**PLANE CARBON COMMUTATOR AND PRODUCING METHOD THEREOF**" by inventor(s) Kenichi SUGIYAMA described in

(x) the specification filed herewith
( ) application Serial No. _____, filed _____
( ) patent No. _____, issued _____

The rights held by the above identified small business concern are exclusive.

I acknowledge the duty to file, in this application or patent, notification of any change in status resulting in loss of entitlement to small entity status prior to paying, or at the time of paying, the earliest of the issue fee or any maintenance fee due after the date on which status as a small entity is no longer appropriate. (37 CFR 1.28(b))

I hereby declare that all statements made herein of my own knowledge are true and that all statements made on information and belief are believed to be true; and further that these statements were made with the knowledge that willful false statements and the like so made are punishable by fine or imprisonment, or both, under Section 1001 of Title 18 of the United States Code, and that such willful false statements may jeopardize the validity of the application, any patent issuing thereon, or any patent to which this verified statement is directed.

NAME OF PERSON SIGNING: Kenichi SUGIYAMA

TITLE OF PERSON OTHER THAN OWNER: President

ADDRESS OF PERSON SIGNING: c/o SUGIYAMA SEISAKUSYO CO., 2-15-21, Meguro-honcho, Meguro-ku, Tokyo, Japan

DATE May 22, 2000 **SIGNATURE** Kenichi Sugiyama

PLANE CARBON COMMUTATOR AND PRODUCING METHOD THEREOF

BACKGROUND OF THE INVENTION

1. Field of the Invention

The present invention relates to a plane carbon commutator used as a commutator for a motor of a fuel pump and the like, and to a producing method of the plane carbon commutator. More particularly, the present invention relates to a plane carbon commutator fore reliably connect segment and carbon in the commutator, and to a producing method of the plane carbon commutator.

2. Description of the Related Art

A plane carbon commutator comprises a metal segment attached to an end face of a commutator body made of mold resin, and carbon attached to the segment. As a producing method of this kind of plane carbon commutator, there are the following methods (A) to (D) for example.

(A) When carbon is formed, a base metal which is a segment is inserted into the carbon and the base metal and the carbon are integrally formed and burnt and then, the base metal which was integrally molded with the carbon is integrally molded with the mold resin, thereby forming an insulator portion (see Japanese Patent Application Laid-open No. H7-264812 for example).

(B) An insulator and a metal base are previously integrally formed by integrally molding or the like and then, carbon is attached to a face of the metal base by soldering or conductive adhesive (see Japanese Patent Application Laid-open No. H5-502974 for example).

(C) An insulator and a metal base are previously integrally formed by integrally molding or the like and then, carbon is formed on a face of the metal base and burnt (see Japanese Utility Model Publication No. H7-42223 for example).

(D) An insulator and a metal base are previously prepared separately, and when carbon is formed, the metal base and the insulator are

integrally molded with the carbon (see Japanese Patent Application Laid-open No. H6-178503 for example).

In the method (A), a temperature for burning the carbon is high as higher as about 600°C or higher. Therefore, the integrally formed metal base is softened, and the product has a problem in terms of precision and strength. Thereupon, the carbon can be burnt at a low temperature about 200°C, but in such a case, the quality of material of the carbon itself becomes special, and there is a problem in various characteristics such as hardness, electrical resistance and gasoline resistance.

In the method (B), the carbon can be previously burnt singly, and there is no problem in the quality of material of the carbon itself. However, if the carbon is soldered to the face of the metal base, there is an adverse possibility that the solder is loosened by a high temperature of wire at the time of assembling of a motor.

If the metal base and the carbon are adhered by the conductive adhesive, this structure requires an adhesive having both conductive property and gasoline resistance, which is expensive. Further, even if the adhesive has the conductive property, electrical resistance thereof is greater as compared with the carbon and the metal base, and there is a problem that this portion is prone to generate heat and a material thereof is prone to be changed when a motor is driven.

In the method (C), the insulator made of resin is carbonized by a high temperature when the carbon is burnt on the face of the metal base. Therefore, the carbon must be burnt at a low temperature, and there is a problem in the quality of material of the carbon.

The method (D) has the same problem as that of the method (C).

Thereupon, in order to solve the above-described conventional problems, the present assignee filed Japanese Patent Application No. H9-51991 (Japanese Patent Application Laid-open No. 10-4653, which will be referred to as "prior example" hereinafter). In the prior example, a segment is formed with an engaging hole, and an engaging projection provided with carbon that was previously burnt at a high temperature is engaged into the engaging hole and integrally formed as one piece. Therefore, the segment and the carbon can be integrally formed with out using solder or adhesive, and the initial object could be achieved.

In the prior example, when the engaging projection formed on the

carbon is engage with the engaging hole formed on the segment and attached and integrally formed, shrinkage fit and press-fit are carried out, and after the engaging projection is engaged with and inserted into the engaging hole, burring or the like is carried out. The engaging projection is fastened by a projection formed by the burring.

Therefore, when the engaging projection of the carbon is inserted into the engaging hold of the segment and both of them are integrally formed, there is a problem that the process for integrally forming them is troublesome.

SUMMARY OF THE INVENTION

It is an object of the present invention to solve the problems described above.

According to a first aspect of the present invention, there is provided a plane carbon commutator comprising a plurality of metal segments fixed to a commutator body made of resin, engaging projections provided on a carbon which was previously burnt at a high temperature, said engaging projections being engaged with engaging holes provided in said segments and integrally formed as one unit, wherein tip ends of cut-rising pieces functioning to allow insertion of said engaging projections into said engaging holes but prevent said engaging holes from being pulled out from said engaging holes are projected from peripheral edges of said engaging holes, and said cut-rising pieces are brought into contact under pressure with peripheral faces of said engaging projections.

According to a second aspect of the present invention, in the plane carbon commutator of the first aspect, peripheral faces of tip end side engaging projections which have passed through said engaging holes provided in said segments are formed into coarse faces by said cut-rising pieces provided on said peripheral edges of said engaging holes.

According to a third aspect of the present invention, in the plane carbon commutator of the first or the second aspect, conductive paste is interposed between said segments and said carbon.

According to a fourth aspect of the present invention, there is provided a producing method of a plane carbon commutator comprising a plurality of metal segments fixed to a commutator body made of resin, and carbon, said segments and said carbon are integrally fixed to each other,

wherein said method comprises the steps of: (a) forming peripheral faces of said engaging projections into coarse faces when engaging projections formed on said carbon are inserted into engaging holes formed in a metal base which will become said segments in order to integrally form said carbon which was previously burnt at a high temperature and said metal base; (b) integrally forming said metal base and said carbon and then, coating the entire exposed face of said carbon with mold resin when said engaging projections formed on said carbon are inserted into said engaging holes formed in said metal base; (c) cutting said metal base into each segment and at the same time, cutting said carbon; and (d) removing said mold resin from a contact face between said carbon and a brush.

BRIEF DESCRIPTION OF THE DRAWINGS

Figs. 1A and 1B are explanatory diagrams of a plane carbon commutator according to the present invention;

Figs. 2A and 2B are explanatory diagrams of a metal base;

Fig. 3 is an explanatory diagram showing a state in which the carbon is mounted to the metal base;

Figs. 4A and 4B are explanatory diagrams of the carbon;

Fig. 5 is an explanatory diagram showing an engaged state between an engaging hole of the metal base and an iii projection of the carbon; and

Fig. 6 is an explanatory diagram showing a state in which the carbon is coated with mold resin.

DETAILED DESCRIPTION OF PREFERRED EMBODIMENT

As shown in Fig. 1, a plane carbon commutator 1 according to the present embodiment comprises a commutator body 3 made of mold resin, a plurality of segments 5 made of metal such as copper or copper alloy integrally fixed to an end face of the commutator body 3, and carbon 7 integrally fixed to the segments 5.

Each of the segments 5 includes a plurality of anchor claws 9 embedded in the commutator body 3, and a wire bonding portion 11.

The commutator 1 is produced as follows. That is, as is known, an annular metal base 15 (see Fig. 2) provided at its inner and outer peripheral edges with portions which will become the anchor claws 9 and the wire bonding portion 11, and provided with portions which will be cut and

separated by the plurality of segments 5 by forming slits 27 is formed. The metal base 15 is formed by stamping using punching.

At that time, in the present embodiment, engaging holes 5H (see Fig. 2) respectively corresponding to the segments 5 are formed in the metal base 15 by stamping and at the same time, a plurality of cut-rising pieces 5T having inwardly projecting tip ends are formed on peripheral edges of the engaging holes 5H.

Next, as shown in Fig. 2, the anchor claws 9 and the wire bonding portion 11 of the metal base 15 are bent toward one side (in the pointing direction of the tip ends of the cut-rising pieces 5T). Then, as shown in Fig. 3, carbon 17 that was previously burnt into a doughnut shape at a high temperature is integrally fixed to the metal base 15. In order to integrally fix the metal base 15 and the carbon 17 to each other in this manner, as shown in Fig. 4, the doughnut-shaped carbon 17 is provided at its one side with a plurality of engaging projections 17P. As shown in Fig. 2, the metal base 15 is provided with engaging holes 5H formed in correspondence to the wire bonding portions 11, and as shown in Fig. 3, the engaging projections 17P are engaged with and inserted to the engaging holes 5H and integrally formed.

As described above, before the engaging projections 17P of the carbon 17 are inserted into and engaged with the engaging holes 5H, conductive paste is applied to peripheral faces of the engaging projections 17P, inner peripheral faces of the engaging holes 5H or appropriate regions in the vicinity thereof.

Thereafter, when the engaging holes 5H are inserted and engaged with the engaging holes 5H, the tip ends of the cut-rising pieces 5T provided on the engaging holes 5H come into contact with the peripheral faces of the engaging projections 17P such that the cut-rising pieces 5T strongly push the peripheral faces. Therefore, the peripheral faces of the engaging projections 17P receive trimming effect and generate scuff mark, and the peripheral faces of the engaging projections 17P are formed into coarse faces. As shown in Fig. 5, outer peripheral faces of the cut-rising pieces 5T and the engaging projections 17P are formed with accumulating portions 19 made of conductive paste, and with the conductive paste, the conductivity is further enhanced.

If the engaging projections 17P of the carbon 17 are inserted and

engaged with the engaging holes 5H as described above, the tip ends of the plurality of cut-rising pieces 5T are brought into contact with the peripheral faces of the engaging projections 17P under pressure and the tip ends dig into the peripheral faces, which makes it difficult to pull out the engaging projections 17P from the engaging holes 5H.

That is, the cut-rising pieces 5T allow the engaging projections 17P to be inserted into the engaging holes 5H, but when a force for pulling out the engaging projections 17P from the engaging holes 5H is acting, the cut-rising pieces 5T function such that the tip ends thereof dig into the peripheral faces of the engaging projections 17P to prevent the latter from being pulled out. In other word, the cut-rising pieces 5T function as a ratchet that only allows the relative movement in the inserting direction and prevent the relative movement in the opposite direction.

Therefore, in the operation for inserting the engaging projections 17P of the carbon 17 into the engaging holes 5H of the metal base 15, both the members can be formed integrally. Thus, it is easy to insert the engaging projections 17P into the engaging holes 5H, and after the inserting and engaging operation, special operation such as fluing operation is unnecessary unlike the prior example, and both the members can easily be formed integrally.

After the engaging projections 17P of the carbon 17 were inserted into and engaged with the engaging holes 5H of the metal base 15 and integrally formed as described above, the integrally formed material is set in a mold cavity (not shown), mold resin 23 is molded to form the commutator body 3. As shown in Fig. 6, the mold resin 23 is molded such that the entire face of the exposed face of the carbon 17 is coated or covered.

When the mold resin 23 is molded as described above, since the tip end side peripheral faces of the engaging projections 17P of the carbon 17 are formed into coarse faces by the cut-rising pieces 5T provided on the peripheral edges of the engaging holes 5H, the connecting strength between the engaging projections 17P and the mold resin 23 is enhanced.

After the mold resin 23 was molded as described above, the wire bonding portion 11 is subjected to necessary bending, and a hole 25 for fitting a motor shaft is subjected to cutting working as shown in Fig. 1. After the slit 27 was subjected to working, the carbon 17 and the metal base

15 are divided into each of segments 5. Then, the mold resin 23 is removed from a contact face with a brush B of the motor by cutting or the like, thereby obtaining a plane carbon commutator 1 as shown in Fig. 1.

As understood from the above description, according to the present embodiment, the entire face of the exposed face of the carbon 17 is coated with the mold resin 23 and in this state, necessary working is carried out, and the mold resin 23 is removed from the sliding face of the carbon in a final step. Therefore, the mold resin 23 protects the carbon in each of various working steps. Thus, the carbon is protected from damage such as crack or chip during the bending of the wire bonding portion 11 and working step of the hole 25.

Further, according to the present embodiment, since the carbon 17 and the segments 5 are integrally fixed to each other by inserting and engaging the engaging projections 17P of the carbon 17 which were previously burnt at a high temperature into and with the engaging holes 5H of the metal base 15, the characteristics of the carbon which was burnt at a high temperature can be utilized, and there is no problem of soldering or adhesive.

As understood from the above explanation, according to the present invention, the peripheral edges of the engaging holes provided on the segments are provided with cut-rising pieces which function to allow the insertion of the engaging projections of the carbon into the engaging holes but prevent the engaging projections from being pulled out. The tip ends of the engaging holes are projected inward and brought into contact with the peripheral faces of the engaging projections. Therefore, in the operation for inserting and engaging the engaging projections into and with the engaging holes, the segments and the carbon can be made integrally, and it is easy to integrally form them, and the segments are held by the carbon reliably.

Further, when the engaging projections are inserted and engaged into and with the engaging holes, since the peripheral faces of the engaging projections are formed into coarse faces, it is unnecessary to form the peripheral faces of the engaging projections into coarse faces, and the connecting strength between the engaging projections and the mold resin when the latter is molded is enhanced.

Further, since the accumulating portions formed between the inner

peripheral faces of the engaging holes and the outer peripheral faces of the engaging projections are electrically connected through the conductive paste, the conductivity is further enhanced.

WHAT IS CLAIMED IS:

1. A plane carbon commutator comprising a plurality of metal segments fixed to a commutator body made of resin, and engaging projections provided on a carbon which was previously burnt at a high temperature, said engaging projections being engaged with engaging holes provided in said segments and integrally formed as one unit, wherein tip ends of cut-rising pieces functioning to allow insertion of said engaging projections into said engaging holes but prevent said engaging holes from being pulled out from said engaging holes are projected from peripheral edges of said engaging holes, and said cut-rising pieces are brought into contact under pressure with peripheral faces of said engaging projections.

2. A plane carbon commutator according to claim 1, wherein peripheral faces of tip end side engaging projections which have passed through said engaging holes provided in said segments are formed into coarse faces by said cut-rising pieces provided on said peripheral edges of said engaging holes.

3. A plane carbon commutator according to claim 1, wherein conductive paste is interposed between said segments and said carbon.

4. A producing method of a plane carbon commutator comprising a plurality of metal segments fixed to a commutator body made of resin, and carbon, said segments and said carbon are integrally fixed to each other, wherein said method comprises the steps of:

(a) forming peripheral faces of said engaging projections into coarse faces when engaging projections formed on said carbon are inserted into engaging holes formed in a metal base which will become said segments in order to integrally form said carbon which was previously burnt at a high temperature and said metal base;

(b) integrally forming said metal base and said carbon and then, coating the entire exposed face of said carbon with mold resin when said engaging projections formed on said carbon are inserted into said engaging holes formed in said metal base;

(c) cutting said metal base into each segment and at the same time, cutting said carbon ; and

(d) removing said mold resin from a contact face between said carbon and a brush.

ABSTRACT OF THE DISCLOSURE

It is an object of the present invention to provide a plane commutator in which it is easy to integrally form carbon and segment, connecting strength between the carbon and mold resin is enhanced, and conductivity is enhanced. To achieve the object, there is provided a plane carbon commutator comprising a plurality of metal segments 5 fixed to a commutator body 3 made of resin, engaging projections 17P provided on a carbon 7 which was previously burnt at a high temperature, the engaging projections 17P being engaged with engaging holes 5H provided in the segments 5 and integrally formed as one unit, wherein tip ends of cut-rising pieces 5T functioning to allow insertion of the engaging projections 17P into the engaging holes 5H but prevent the engaging holes 5H from being pulled out from the engaging holes 5H are projected from peripheral edges of the engaging holes 5H, and the cut-rising pieces 5T are brought into contact under pressure with peripheral faces of the engaging projections 17P. Peripheral faces of tip end side engaging projections 17P are formed into coarse faces, and conductive paste is interposed between the segments 5 and the carbon 7.

FIG.1A

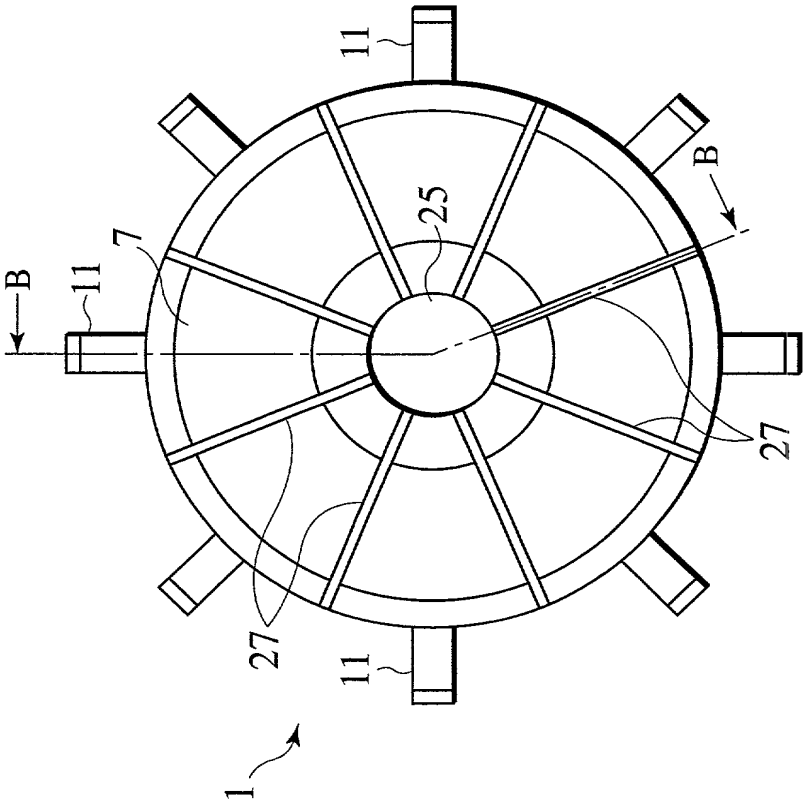


FIG.1B

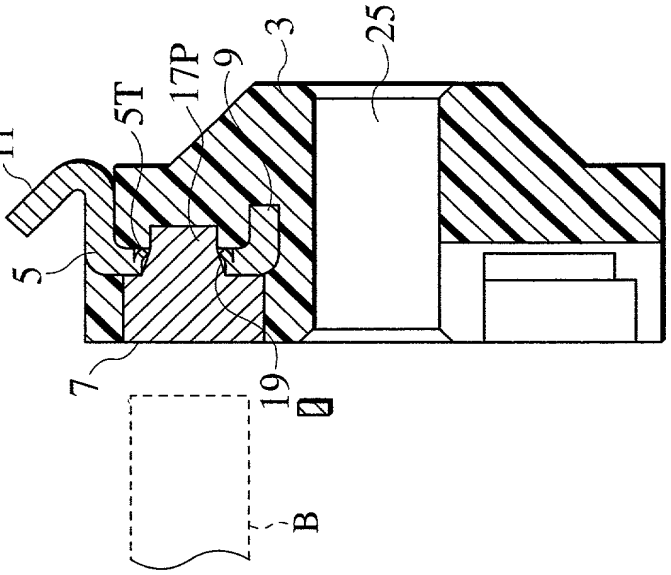


FIG.2A

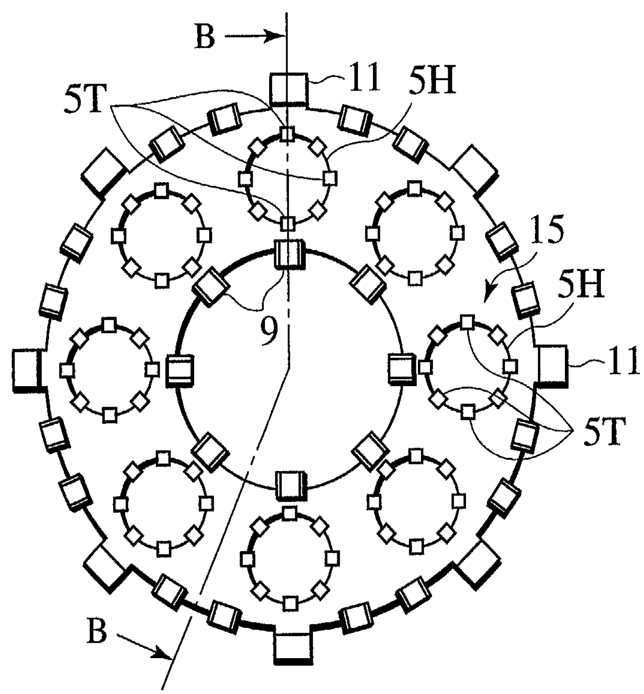


FIG.2B

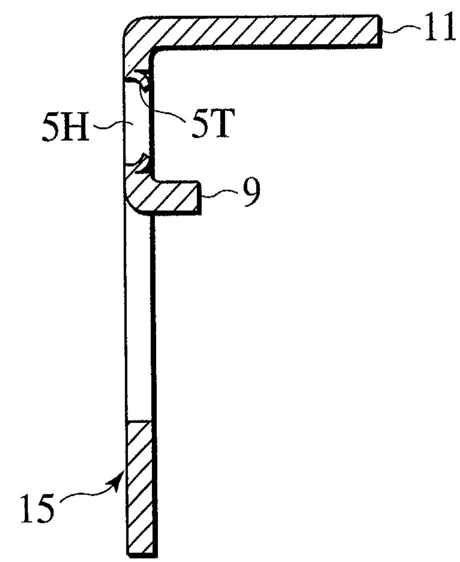


FIG.3

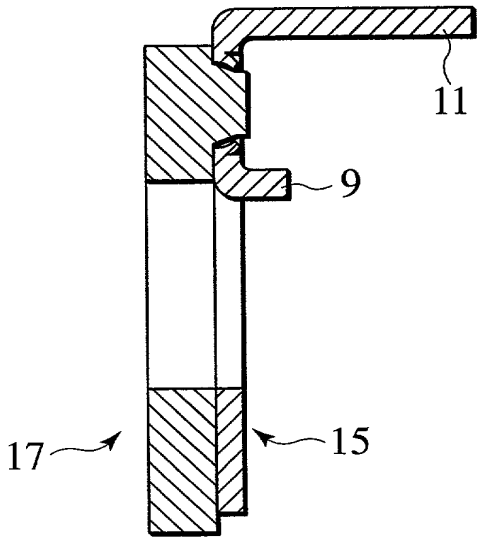


FIG.4A

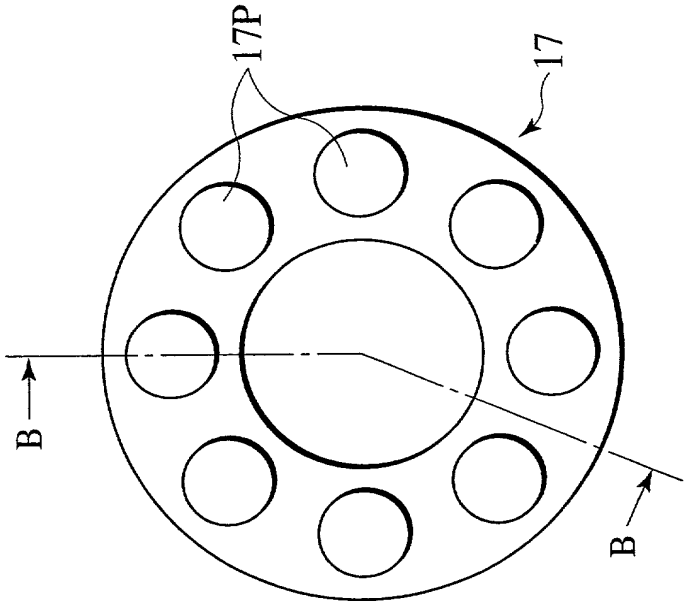


FIG.4B

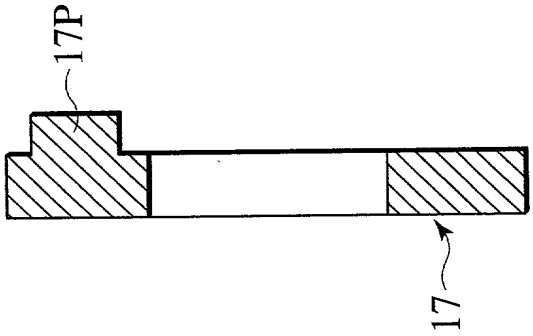


FIG.5

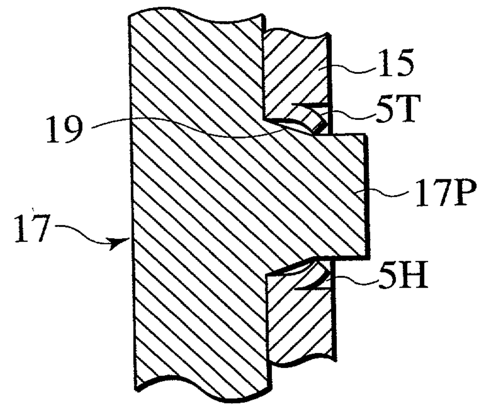
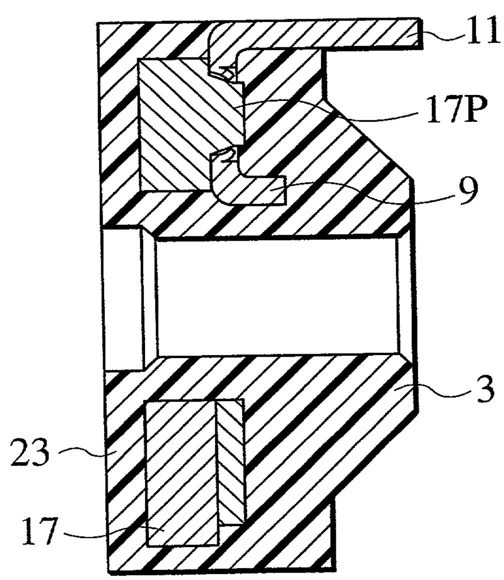


FIG.6



DECLARATION AND POWER OF ATTORNEY Attorney's Docket No. 13700-0238

As a below named inventor, I hereby declare that:

My residence, post office address and citizenship are as stated below next to my name. I believe I am the original, first and sole inventor (if only one name is listed below) or an original, first and joint inventor (if plural names are listed below) of the subject matter which is claimed and for which a patent is sought on the invention entitled: PLANE CARBON COMMUTATOR AND PRODUCING METHOD THEREOF, the specification of which

☒ is attached hereto.

☐ was filed on _____ as application Serial No. _____ (if applicable) and was amended on _____.

I hereby state that I have reviewed and understand the contents of the above-identified specification, including the claims, as amended by any amendment referred to above. I do not know and do not believe that the same was ever known or used by others in the United States of America before my or our invention thereof, or patented or described in any printed publication in any country before my or our invention thereof or more than one year prior to the date of this application. I further state that the invention was not in public use or on sale in the United States of America more than one year prior to the date of this application. *I understand that I have a duty of candor and good faith toward the Patent and Trademark Office,* and I acknowledge the duty to disclose information which is material to the examination of this application in accordance with Title 37, Code of Federal Regulations, §1.56(a). I further understand that information is "material" where there is a substantial likelihood that a reasonable patent examiner would consider the information important in deciding whether to allow the application to issue as a patent.

I hereby claim foreign priority benefits under Title 35, United States Code, §119 of my foreign application(s) for patent or inventor's certificate listed below, and have also identified below any foreign application for patent or inventor's certificate disclosing subject matter in common with the above-identified specification and having a filing date before that of the application on which priority is claimed:

Country	App. No.	Date of Filing	Priority Claimed Under 35 USC §119
Japan	P10-328387	November 18, 1998	Yes _____ No X

I hereby claim the benefit under Title 35, United States Code, §120 of any United States application(s) listed below and, insofar as the subject matter of each of the claims of this application is not disclosed in the prior United States application in the manner provided by the first paragraph of Title 35, United States Code §112, I acknowledge the duty to disclose material information as defined in Title 37, Code of Federal Regulations, §1.56(a) which occurred between the filing date of the prior application and the national or PCT international filing date of this application:

Application Serial No.	Filing Date	Status: patented, pending, abandoned

I further declare that all statements made herein of my own knowledge are true and that all statements made on information and belief are believed to be true; and further that these statement were made with the knowledge that willful false statements and the like so made are punishable by fine or imprisonment, or both, under Section 1001 of Title 18 of the United States Code, and that such willful false statements may jeopardize the validity of the application or any patents issuing thereon.

I hereby authorize the U.S. attorneys named herein to accept and follow instructions from **Miyoshi & Miyoshi,** as to any action to be taken in the Patent and Trademark Office regarding this application, without direct communication between the U.S. attorney and the undersigned. In the event of a change in the persons from whom instructions may be taken, the U.S. attorney named herein will be notified by the undersigned.

POWER OF ATTORNEY: The following attorneys are hereby appointed to prosecute this application and transact all business in the Patent and Trademark Office connected therewith: Anthony B. Askew - 24,154; Roger T. Frost - 22,176; Jeffrey E. Young - 28,490; Robert E. Richards - 29,105; John R. Harris - 30,388; Stephen M. Schaetzel -31,418; Larry A. Roberts - 31,871; Thomas A. Hodge, - 22,602; Charles L. Warner II - 32,320; Gregory T. Gronholm - 32,415; Dale Lischer - 28,438; Peter G. Pappas - 33,205; James Dean Johnson - 31,771; Nora M. Tocups - 35,717; W. Scott Petty - 35,645; Daniel J. Warren - 34,272; Hubert J. Barnhardt III - 36,739; Virginia L. Carron - 37,110; Leona G. Young - 37,266; Jamie L. Greene-32,467; William A. Hartselle - 36,548; Holmes J. Hawkins III - 38,913; Mary Anthony Merchant - 39,771; Michael J. Mehrman - 40,086; William L. Warren - 36,714; Felipe J. Farley - 38,445; F. Leslie Bessenger III - 39,108; James A. Witherspoon - 36,723; Brenda M. Ozaki - 40,339; James D. Withers - 40,376; M. Todd Mitchem - P40,731; Gregory S. Smith - P40,819.

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Inventor's signature	Kenichi Sugiyama. Date: May 22, 2000

☐ Additional inventors are being named on separately numbered sheets attached hereto.